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INSECT MIGRATIONS AS RELATED TO THOSE OF BIRDS

BY HOWARD J. SHANNON

JAMAICA, N. Y.

MOST of us know that many great flight-ways of migratory birds have been accurately mapped out both on the European continent and on our own. But no systematic attempt has ever been made to determine the flight-lines of migratory insects. In fact, it has hardly been suggested that such lines of travel exist. Significant movements, however, observed by the writer while stationed upon the southern Long Island coast seemed to indicate that both "monarch" butterflies as well as certain dragonflies habitually travel westward along that shore, and for many autumnal days in succession, in an apparent attempt to reach the mainland and an overland southward route to the tropic zone. These studies then not only suggested the theory that *both* insects were true seasonal migrants like birds, but also that similar avenues of travel must exist in other parts of the country. This conclusion has been strikingly upheld by further explorations. For, from additional evidence gathered in the field and by means of an extensive correspondence, it now becomes possible to define some of the principal insect highways of eastern North America. These should become the basis for the study of what is virtually a new science—the bionomics of seasonal insect migrations.

One such route evidently extends along the eastern coast from the far Canadian territory to the Gulf States. For, although the Maine-coast record of a "monarch" flight is the most northerly that has been reported, many of these migrants must be directed to these natural highways soon after leaving their summer habitat in the farther north. Both this record and most others reported along the seaboard are described as "butterfly processions" faithfully following the trend of the shore whatever its local direction. For they even turn westward along the Connecticut shore of the Sound (as recently observed by the writer), and beautifully parallel their similar coastwise behavior on the southern Long Island ocean coast.

In both cases, of course, they are bound for New Jersey; and thence continue southward until the waters of Chesapeake Bay seem to cause a partial, sidewise diversion. For a great swarm, moving at a considerable elevation, was seen in the year 1886, flying southward near the headwaters at West River, Maryland, which is situated far inland. Other scattered flights have been seen in the streets of Washington. But whether these are all isolated occurrence or bands moving from the interior remains to be discovered. However, the great "resting swarms" reported at Charleston Harbor, South Carolina, show that many of the insects either preserve, or else recover, their coastwise habit, and persist in this extensive, continental flightway, whose further course, or possible termination, remains to be defined.

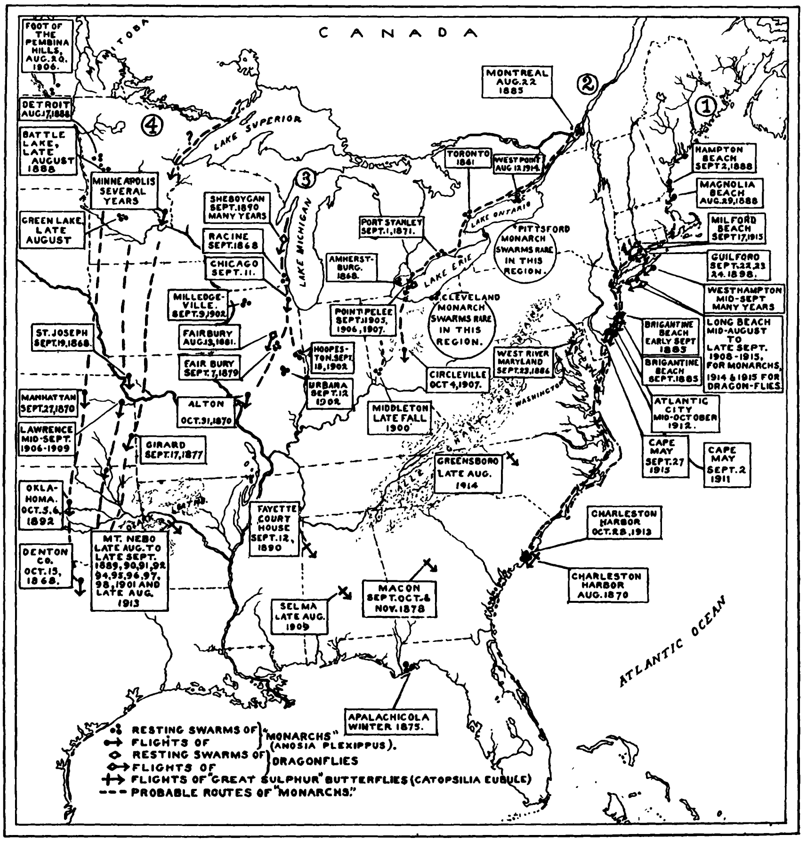
CANADA
MANITOBA
FOOT OF THE PEMBINA HILLS, AUG. 20. 1906.
DETROIT AUG.17,1888
BATTLE LAKE, LATE AUGUST 1888
④
LAKE SUPERIOR
MINNEAPOLIS SEVERAL YEARS
GREEN LAKE LATE AUGUST
③
SHEBOYGAN SEPT.1890 MANY YEARS
RACINE SEPT.1868
CHICAGO SEPT. 11.
LAKE MICHIGAN
MILLEDGEVILLE. SEPT.9,1902
FAIRBURY AUG.13,1881.
FAIR BURY SEPT. 7,1879
ST. JOSEPH SEPT.19,1868.
MANHATTAN SEPT.27,1870
LAWRENCE MID-SEPT. 1906-1909
ALTON OCT.31,1870
GIRARD SEPT.17,1877
OKLAHOMA. OCT.5,6. 1892
DENTON CO. OCT.15, 1868.
MT. NEBO LATE AUG. TO LATE SEPT. 1889, 90, 91, 92 94, 95, 96, 97, 98, 1901 AND LATE AUG. 1913
HOOPESTON. SEPT. 18,1902
URBANA SEPT.12 1902
AMHERSTBURG. 1868.
PORT STANLEY SEPT.1,1871.
POINT PELEE SEPT.11905, 1906, 1907.
MIDDLETON LATE FALL 1900
CIRCLEVILLE OCT 4,1907.
CLEVELAND MONARCH SWARMS RARE IN THIS REGION.
LAKE ERIE
LAKE ONTARIO
TORONTO 1861
WEST POINT AUG 12,1914.
PITTSFORD MONARCH SWARMS RARE IN THIS REGION.
MONTREAL AUG.22 1885
②
①
HAMPTON BEACH SEPT 2,1888
MAGNOLIA BEACH AUG.29,1888
MILFORD BEACH SEPT17,1915
GUILFORD SEPT.22,23 24.1898.
WESTHAMPTON MID-SEPT MANY YEARS
LONG BEACH MID-AUGUST TO LATE SEPT. 1908-1915, FOR MONARCHS, 1914 & 1915 FOR DRAGON-FLIES.
BRIGANTINE BEACH EARLY SEPT 1885
BRIGANTINE BEACH SEPT.1885
WEST RIVER MARYLAND SEPT.23,1886
WASHINGTON
ATLANTIC CITY MID-OCTOBER 1912.
CAPE MAY SEPT.27 1915
CAPE MAY SEPT.2 1911
GREENSBORO LATE AUG. 1914
FAYETTE COURT HOUSE SEPT.12, 1890
CHARLESTON HARBOR OCT.28,1913
CHARLESTON HARBOR AUG.1870
MACON SEPT.OCT.& NOV.1878
SELMA LATE AUG. 1909
APALACHICOLA WINTER 1875.
ATLANTIC OCEAN
RESTING SWARMS OF } "MONARCHS" (ANOSIA PLEXIPPUS).
FLIGHTS OF
RESTING SWARMS OF } DRAGONFLIES
FLIGHTS OF
FLIGHTS OF "GREAT SULPHUR" BUTTERFLIES (CATOPSILIA EUBULE)
PROBABLE ROUTES OF "MONARCHS."

FIG. 1. AUTUMN INSECT ROUTES TO THE SOUTH. At least four great flightways are defined, (1) by the Atlantic Coast, (2) and (3) by the Great Lakes, and (4) by the West Central States. The great sulphur's inland flights in the South seem to move on a broader front except in the Ozark Mountains. (Map from the U. S. Geological Survey.)

Farther west, along the northern shores of Lake Ontario and Lake Erie, another great route must exist, *even though no flights have been reported as moving in that general direction.* This flight-line was first suggested by reason of the steady, uninterrupted streams of "monarchs" reported by the bird student, Taverner, as coming down from the north, and then flying along Point Pelée, a peninsula jutting southward from the northern shore of western Lake Erie. For they predicated some great, and probably specific, source of supply in the Canadian region. As a matter of fact, the territory immediately to the north was first considered the probable source of this living butterfly stream. But few, if any, records could be found in that region. What previous trail then could these myriads have followed other than the northern shores of the Lakes, as these were perfectly natural lanes of travel if the behavior already observed in the east could be duplicated here? For it would seem that, in this region too, most of the butterflies coming down from northeastern Canada would be held back and deflected by these water barriers, just as they are in Connecticut and Long Island by the Sound and ocean shore.

Only the evidence then was needed. This was readily supplied by reports of *resting swarms* at Port Stanley, Toronto, Montreal (for the route may even extend along the St. Lawrence Valley), and by the interesting description of "thousands, even hundreds of thousands of the red-winged butterflies *resting* on the shores of Lake Ontario at West Point," which was communicated to the writer by Miss Esther Steele, of Pittsford, N. Y. Moreover, this same observer reports that the butterflies never appear in any great numbers in this home region, almost directly opposite West Point, but near the southern shore, indicating that the insects rarely, if ever, cross the lake. This supposition is even further confirmed by another observer who *did* see a swarm at Cleveland, on the southern shore of Lake Erie; but who supplements his record with the statement, "they are seldom seen in this locality." Evidently, then, the "monarchs" usually avoid these great water barriers, preferring to traverse the 500 mile route already outlined, only to flood southward in the released stream which finds its outlet along Point Pelée and the contiguous islands leading to the Ohio shore, thence the flights probably continue directly southward, as shown by the record at Circleville; but after that point is reached our knowledge of their further course is lost.

Still another great route has been indicated along the west shore of Lake Michigan by reason of the swarms reported at Racine and Chicago. This flight-line, also, probably represents a released stream whose source lies still further north in some undetermined region beyond the Great Lakes. Its outlet toward the south, however, is shown by numerous reports throughout central and eastern Illinois, and, probably, by the flight still farther down country at Alton, where this tenuous thread, linking the insects of the temperate and the tropic zones, is lost.

But the wide highways of the Great Plains and the West Central States offer the most frequent reports of remarkable butterfly spectacles. In fact, they are so common in Minnesota, Iowa, Kansas, Oklahoma and eastern Texas that they probably represent a mingling of various streams from Manitoba, the farther Canadian territory, and even from the northern shores of Lake Superior where a flight-line probably trends west only to turn south after passing the lake's extremity. The result is shown in gatherings of almost unbelievable magnitude. For here, unobstructed by barriers of lake, or ocean or mountain height, such as in other regions deflect and crowd the travelers into single-file processions, the mingled myriads move forward in broader, freer swarms that mount high, forming veritable crimson clouds; and in these impressive congregations—miles in width and streaming backward for equal distances—the crowding, ever-fluttering wings press onward toward the south, casting below them as they go perceptible shadows that move in company with the brilliant travelers in flight above the sunlit plains.

Vast aerial armies of dragonflies also advance along certain of the highways, although the scattered and broken processions are the usual mode of travel. Moreover, by using the routes already determined as a key, further confirmations are obtained regarding the seasonal character of their migrations in the manner of birds. For not only does the common Long Island migrant, *Anax junius,* travel southward along the Jersey shore, as shown by Wolff's September observation at Cape May, but also this same species travels westward along the Connecticut shore of the Sound as shown by the writer's August and September observations.

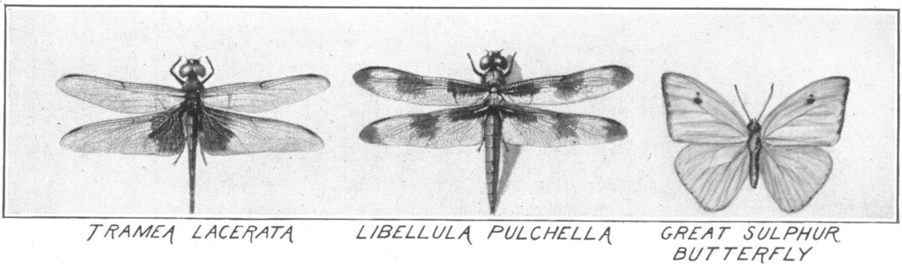

FIG. 2. SOME LITTLE KNOWN MIGRANTS OF NORTH AMERICA. These two interesting dragonflies have never before been reported in migration. The great sulphur, being a Southern butterfly, does not often reach the latitude of New York in any great numbers.

Then, too, a report of *resting swarms,* appearing at Point Pelée (the butterfly route already defined), would seem to show that *Anax* also follows our second great highway along Lakes Erie and Ontario. In fact, still further observations by the same observer, Mr. F. M. Root, show that eight other kinds of dragons, as well, appear at the point in late summer; and, as some species are less profuse in the earlier season, they are apparently migrating to another region. Among them are the beautiful *Libellula pulchella* and the uncommon *Tramea lacerata*. And, as both of these species (as well as *Libellula semifasciata*) have been seen by the writer in extensive autumnal migration on Long Island, it is possible that both of these species, as well, follow the two great eastern routes already defined for the "monarchs."

Indeed, when we realize that great swarms of still another species, *Æschna eremita,* have been seen in annual, September flights at Sheboygan, which is on our third great route along the shore of Lake Michigan; and that the only other autumnal migration reported in detail in this country, that of *Epiæschna heros,* took place at Fairbury, Illinois, which is the direct continuation of the same route, one discovers a remarkably interesting coincidence. It is true that other flight-ways may be defined, and also that a more or less individual wandering course may be followed down country by both insects; but it seems equally true that the great water-barriers of the ocean and the Lakes divert both migrants into the common and crowded paths already described.

Such a fundamental coincidence prepares one for further identities between these routes and the flight-lines of migratory birds. This is, indeed, the remarkably interesting fact. For not only does a great flight-way extend along the eastern coast and along Point Pelée, indicating a coincidence there, but studies at Toronto, by Fleming, suggest that a great east-and-west flight-way for birds may pass through that city, a possible parallel to our second *insect route* along the northern shores of Lake Erie and Lake Ontario.

Regarding the third route along the Michigan shore, as well as the fourth route through the West Central States, it may be said (and this statement also applies to the eastern flight-ways), that the stronger flying birds are not so easily diverted as the insects: their southward flight follows a broader, bolder course. So, although birds doubtless follow a migratory course in most, if not all, of the regions defined above, the presence of feathered travelers on the southern shores of Ontario, and thence down the Genesee Valley, as well as other records farther west, show that the higher flying birds are more independent of land-contours than the feebler insect. And, although the bird is locally diverted by food supplies, the greater numbers of the migrants seem less slavishly diverted by geographical features than the insects which, in many cases, assume a lower habit of flight.

Yet, whatever effect further data may have upon the theory of a *general* similarity of route, there is, in certain local cases, an actual identity or veritable coalescence of the vast stream of mingled life that deviously finds its flooding way to the South. For where certain physical features combine to form narrow contracted flight-ways many types of both creatures are often thrown into a common path which affords a remarkable and convincing spectacle. Needless to say, it is along such crowded highways that further discoveries of the rarer migrants will be made.

Just such a channel is formed by Long Beach, Long Island, where it narrows between ocean and bay. For two irregular lines of dunes also traverse this land-lane, still further narrowing its course and producing a miniature valley along which both feathered and scale-winged migrants multitudinously stream. Swallows begin to sweep past even in mid-August; an occasional humming-bird (seldom noted in the literature of migration owing to the elusiveness of its long flight to Mexico) sometimes hurtles past like a shot released; the eye can hardly follow it. While the ever-present "monarchs" and the various kinds of

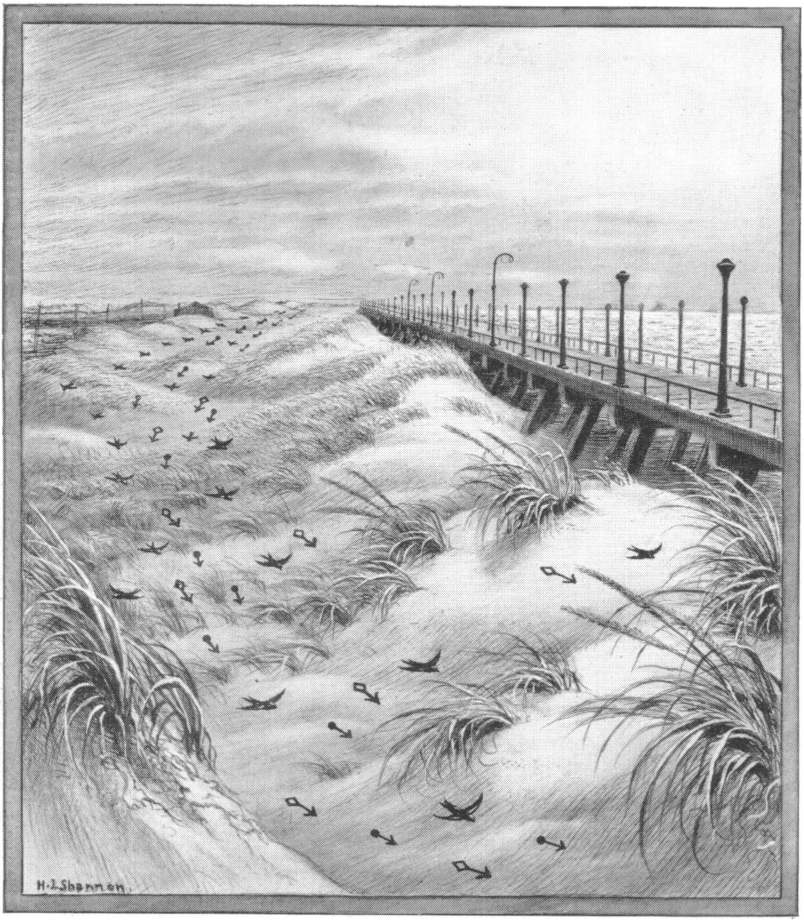

FIG. 3. A CONTRACTED BUT DIRECT FLIGHT-WAY. Where Long Beach narrows between ocean and bay two lines of dunes form a miniature valley. Through it both birds and insects fly side by side, "Monarchs" represented by circle-tipped arrows; dragonflies by lozenge-tipped arrows.

dragonflies conform to an aerial route along the north slopes of the seaward dunes, or in the valley, with a precision so exact that one may take his stand beforehand and find them passing directly overhead or even within reach of one's hand.

Upon broken, irregular coasts quite different behavior is seen: some insects follow one path, others another. So confused and peculiar do some of these flight-ways become, in fact, that they have led to some erroneous conclusions. Just such an instance seems revealed by a letter written in 1901 by Mr. Henry Bird, a resident of Rye on the north shore of Long Island Sound. In correspondence with a Canadian entomologist he says:

> I used to find time for a day's fishing now and then and in a row-boat would anchor a half-mile out from shore on some submerged reef. . . . And one is sure to be struck with the number of butterflies constantly coming from the Island [Long Island] to the main shore. We might expect the supply to be largest on the mainland, and that emigration would be going the other way, yet it is invariably as first stated. By far the largest number seen will be *Archippus* (''monarchs''), next *Papilios* (swallowtails), and *Colias philodice* (clouded sulphur). ''Monarchs'' seem on the wing continually during the last half of the season, and their flight over the Sound waters seems most methodical. But in this case—they are going north, mind—they fly singly.

The Canadian scientist, Mr. J. A. Moffat, then concludes the insects were gathering in the north preparatory to a southward migration.

So curious a happening seemed worthy of further investigation, particularly as insect migrations along the Sound shores had only been predicted by the writer and never definitely proved. So Milford Beach, several miles farther east than Rye, was chosen as the place of observation.

How curious was the phenomenon that presented itself almost immediately upon my arrival during a late August afternoon! For not only were "monarchs," swallowtail butterflies and dragonflies flying from over the water and toward the shore—that is, toward the northwest—but swallows, as well, were accompanying them. All alike continued inland and disappeared from sight beyond the houses and woods in that landward vicinity. So here, almost at once, was a repetition of the peculiar spectacle reported from the Rye shore fourteen years before. What is the solution?

Former Long Island studies, where swallow and insect routes coincide, gave the key to the mystery. For, upon looking far out over the water, it was seen that the swallows were traveling more nearly parallel to the shore, and seemed to be winging their way from some outjutting point of land farther east (rather than from Long Island), in an attempt to pass over the waters of the cove or bay. But on being driven southward by the brisk northwest wind they, as well as the insects, which had evidently set sail from a similar point, were forced to turn north, directly in the face of the breeze, and to beat against it in order to reach the land at all.

Further September studies confirmed this solution. For each outjutting point of land to the east—Welch Point, Pond Point and the lesser projection of Meadow's End—sheltered its resting or hovering companies of "monarchs" and dragonflies. Each point, too, was the launching place for one or another of the insects, or of both; and, although some moved along the curve of shore, many took the more hazardous, but shorter, route over the water. Even Charles Island, midway between the two arms of the cove, held its resting migrants or its westward-flying units, which, owing to the small size of this land area, must have been bred upon the mainland.

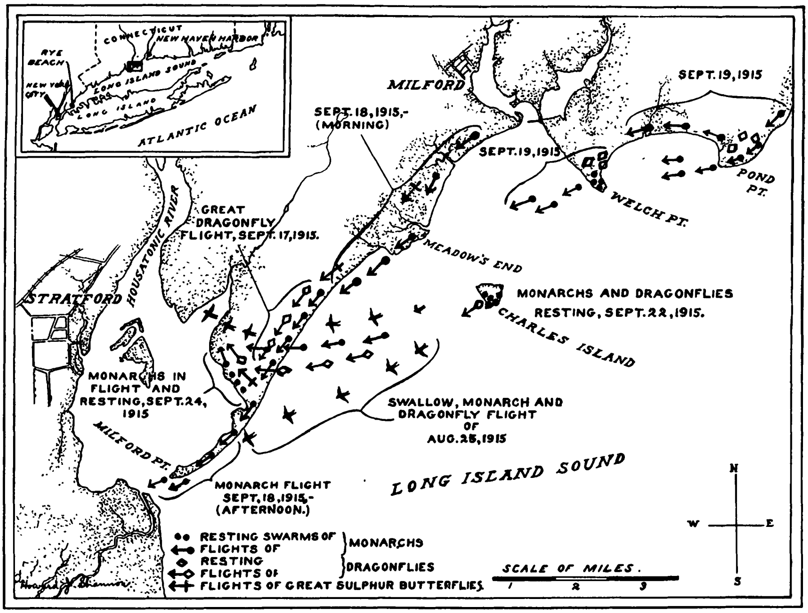
CONNECTICUT
NEW HAVEN HARBOR
RYE BEACH
NEW YORK CITY
LONG ISLAND SOUND
LONG ISLAND
ATLANTIC OCEAN
MILFORD
SEPT. 18, 1915,- (MORNING)
SEPT. 19, 1915
SEPT. 19, 1915
POND PT.
WELCH PT.
GREAT DRAGONFLY FLIGHT, SEPT. 17, 1915.
HOUSATONIC RIVER
STRATFORD
MEADOW'S END
MONARCHS AND DRAGONFLIES RESTING, SEPT. 22, 1915.
CHARLES ISLAND
MONARCHS IN FLIGHT AND RESTING, SEPT. 24, 1915
MILFORD PT.
SWALLOW, MONARCH AND DRAGONFLY FLIGHT OF AUG. 25, 1915
MONARCH FLIGHT SEPT. 18, 1915,- (AFTERNOON.)
LONG ISLAND SOUND
N
W
E
S
●● RESTING SWARMS OF } MONARCHS
←● FLIGHTS OF
◆ RESTING } DRAGONFLIES
←◇ FLIGHTS OF
←+ FLIGHTS OF GREAT SULPHUR BUTTERFLIES
SCALE OF MILES.
1 2 3

FIG. 4. CONFUSED FLIGHT-WAYS ON AN IRREGULAR COAST. On the Sound shore at Milford some insects and birds take short cuts over the water; others follow the trend of the shore. The curious northward movement around the east shore of the Housatonic is probably due to the food supplies found on that wooded shore. Occasionally both "Monarchs" and great sulphur butterflies are seen migrating southwestward through the streets of New York City.

The continued northward flight of both birds and insects, however, even after they have gained the Connecticut shore, seems to require a further explanation. This missing factor *may* be found in the mere presence of the Stratford marshes and the broad Housatonic waters which they border. For, although some migrants pass directly west over Milford Point, over these meadows and the Housatonic River, others (birds and insects alike) sweep northward to circle this submerged area and only turn west, presumably, after passing around its perilous waters. Still the waters alone hardly seem sufficient to account for this northward diversion, as the greater reaches of the bay have been essayed without hesitation. Probably the true reason, then, is found, at least, in part, in the greater food supplies to be gathered along this wooded river-shore. For here the "monarchs" settle and feed; dragonflies hover in midair apparently gathering food, and even the swallows dip and glide as if refreshing themselves according to their usual habit.

This solution is further upheld by Dr. Bishop's careful studies in bird migration near New Haven Harbor, a quite similar body of water ten miles farther east. For here he saw repeatedly, not only swallows which are day migrants, but, also in the early morning, such nocturnal travelers as the bluebirds, robins, warblers, bobolinks and many others, nearly all of which were flying north or northwest along the eastern Harbor Shore. And, although he concludes that they were merely avoiding the wide waters, it seems more probable that they were hugging the land in order to feed after fasting through the long night journey on the wing. Moreover, so close is the parallel, in the writer's opinion, that further scrutiny should discover an insect route along this New Haven shore corresponding to our September flight-way by the Housatonic.

Still another butterfly migrant, the "great sulphur," often follows our Connecticut highways as well as the southern Eastern Shore. But this beautiful southern visitor is so fluctuant in its appearance and, at least beyond the forty-first parallel, is usually represented by so few individuals, that its summer sojourn passes almost unnoticed, and only the patient watcher of our autumn lanes of travel may catch brief, infrequent glimpses of its departing yellow wings.

In southern states it pursues regular, inland trails as well; for records recently communicated to the writer are so superior to any hitherto offered that they form a definite basis for further discovery. While resident at Mt. Nebo, Arkansas, my correspondent, Mrs. Jessie Rose Smith, was the interested observer of autumnal sulphur migrations toward the southeast for a period of ten years! It is true that the same observer has seen other southeastward flights in North Carolina and Alabama; still other students have reported similar movements in Alabama and Georgia as well. But they extend over a very brief period, and even another reference by Scudder, who quotes observations extending over a period of twenty-six years, is so vague in regard to place and direction that it has a secondary value.

But the Mt. Nebo flights, on account of the vast numbers involved, the constancy of their appearance ("we could predict their coming for days beforehand") and the uninterrupted sequence of the movements which began in late August and lasted for many weeks—

all these now familiar phenomena as observed in other insects—aroused the conviction that my correspondent must have been stationed upon some such crowded avenue of travel as has already been described in other parts of the country. Only a cursory glance at the relief map suffices to show the geographical features responsible for these recurring spectacles. For the Ozark Mountains, extending from the northeast to the southwest, lie at right angles to, and form a barrier across, the great sulphur's southeastward migration. So, held back by the hills, they are forced to turn aside and seek an egress to the warmer zone beyond these obstacles. But not until the gateway of the Arkansas Valley opens are the flocking multitudes able to move in the desired direction, and to stream past Mt. Nebo, which stands on the valley border, only to scatter again, no doubt, and move in more open order after passing the contracted flight-way of the hills.

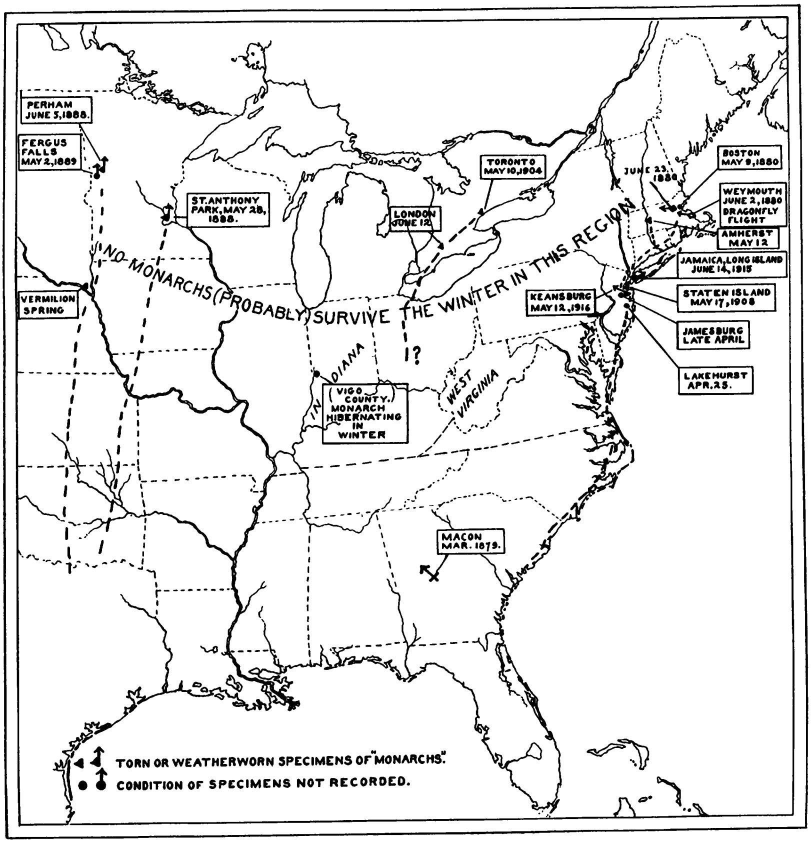
PERHAM JUNE 5,1888.
FERGUS FALLS MAY 2,1889
ST. ANTHONY PARK, MAY 28, 1888.
VERMILION SPRING
NO MONARCHS (PROBABLY) SURVIVE THE WINTER IN THIS REGION
LONDON JUNE 12
TORONTO MAY 10,1904
JUNE 23, 1880
BOSTON MAY 9,1880
WEYMOUTH JUNE 2,1880 DRAGONFLY FLIGHT
AMHERST MAY 12
JAMAICA, LONG ISLAND JUNE 14,1915
KEANSBURG MAY 12,1916
STATEN ISLAND MAY 17,1908
JAMESBURG LATE APRIL
LAKEHURST APR.25.
INDIANA
(VIGO COUNTY.) MONARCH HIBERNATING IN WINTER
I?
WEST VIRGINIA
MACON MAR. 1879.
TORN OR WEATHERWORN SPECIMENS OF "MONARCHS".
CONDITION OF SPECIMENS NOT RECORDED.

FIG. 5. EARLY SPRING APPEARANCES OF "MONARCHS" IN THE NORTH. Their distribution shows that spring routes toward the North are probably somewhat similar to the flight-lines of autumn. It is significant that, in Europe, *both butterfly and dragonfly records of Spring* are the most profuse: here, the autumn flights are the greatest. (Map from the U. S. Geological Survey.)

Unmistakable as these mountain barriers are, however, both they and the lake and ocean obstacles, already noted, seem comparatively slight disturbances when one considers the general regularity of the north and south valleys and coast-lines in North America which are the natural lanes of travel. So, in this country, true insect migration, as well as that of birds, falls into comparatively simple, unobstructed channels. In Europe, on the contrary, the east-and-west position of the great mountain ranges, as well as the ever-varying direction of the coast-line, offer peculiar difficulties to the insect flights which, therefore, become deflected and confused. These conditions alone are sufficient to account for the great varieties of direction reported for dragonfly swarms on that continent. In fact, they may also account for the apparent failure of a true interpretation there; for only the study of our more direct, but corresponding, activities on this continent has seemed to throw a considerable light upon the problem. Butterfly migrations in the old world, too, have shown such varied behavior that the idea of regular seasonal movements rests upon far less definite data than has been obtained in this country. Nevertheless, as the writer has pointed out in a previous article,[1] the recorded instances of dragonfly migrations in Europe remarkably coincide with certain flight-ways of migratory birds; so there, as well, persistent scrutiny of certain continental highways should shed an additional light upon the other insect migrants that travel there.

The more they are studied the more impressive and thought-provoking do these parallel behaviors become, until one seeks to find some complementary light which may be shed by one creature on the activities of the other. For the hitherto almost unnoted spectacle of both life-orders flooding along the same great continental highways quite naturally gives rise to thought and conjecture. Indeed, it is not impossible that the insects, being perhaps the first historic travelers along the highways, attracted the insect-eating birds, resulting in an habitual adherence to those routes, where a constant food-supply could be secured during their long flight to the south. As a matter of fact an early report of a dragonfly swarm passing over Dresden states that "starlings, blackbirds and sparrows accompanied the insects and threw themselves upon them with great eagerness." Still, excepting for hawks, kingbirds, the purple martin and, to a lesser extent, the swallows, dragonflies are not habitually chosen for food. "Monarchs," moreover, are notoriously distasteful to birds. So, as regards these two insects at least, such a theory finds little support.

Nevertheless, there may be *even other forms of insect life* which habitually use the great highways—quite different insects which *would be* desirable for food. In the writer's opinion there are considerable evidences to uphold this contention. A large bumble bee (or bee resembling fly as yet undetermined) has been seen driving steadily westward along both the Long Island and Connecticut highways, in each case flying side by side with the "monarchs." Along the Maine coast, too, according to a communication from Mr. Norton of the Portland Natural History Society, large bumble bees have been observed flying steadily westward across the water between the offshore islands and following the same general route which "monarchs" and birds pursue.

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[1] "Do Insects Migrate Like Birds?" *Harpers Magazine*, Sept., 1915.

Certain small flies, *Ilythea,* have been reported by Scudder, migrating along the New Hampshire coast in the same general direction already followed by a late summer "monarch" procession. The dragonfly swarms reported by Root on Point Pelée were preceded by large flocks of "deer flies" that seemed a part of the seasonal movement; while Eimer prefaces his description of a dragonfly flight in Switzerland by saying that swarms of the "flower flies" *Eristalis tenax* and *Syrphus lavandulæ* preceded the dragonflies, which were then upon a southward, September migration. So, as great numbers of *Eristalis tenax* have been seen resting along the Long Island highway where they are rare in the earlier season, further studies may establish a definite connection between these movements and the flights of certain insect-eating birds.

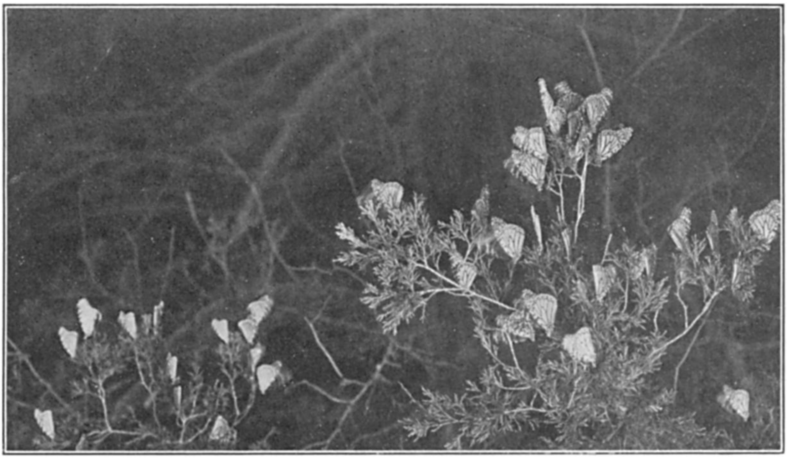

Fig. 6. "MONARCHS" RESTING ON THEIR MIGRATION THROUGH KANSAS. This flash-light photograph, published through the courtesy of Miss Jennie Brooks, represents a part of the Lawrence swarm of 1909 described by her in Country Life for August, 1911. In 1906 larger swarms, also described by Miss Brooks in Harpers for June, 1907, rested for the night on the same tree.

It is not impossible, in fact, that such a southward trend, or diminution of the smaller insects in the farther north, may take place in sufficient measure to account for the initial movements of the dragonflies. Certainly it does not seem true in this local region. For when the

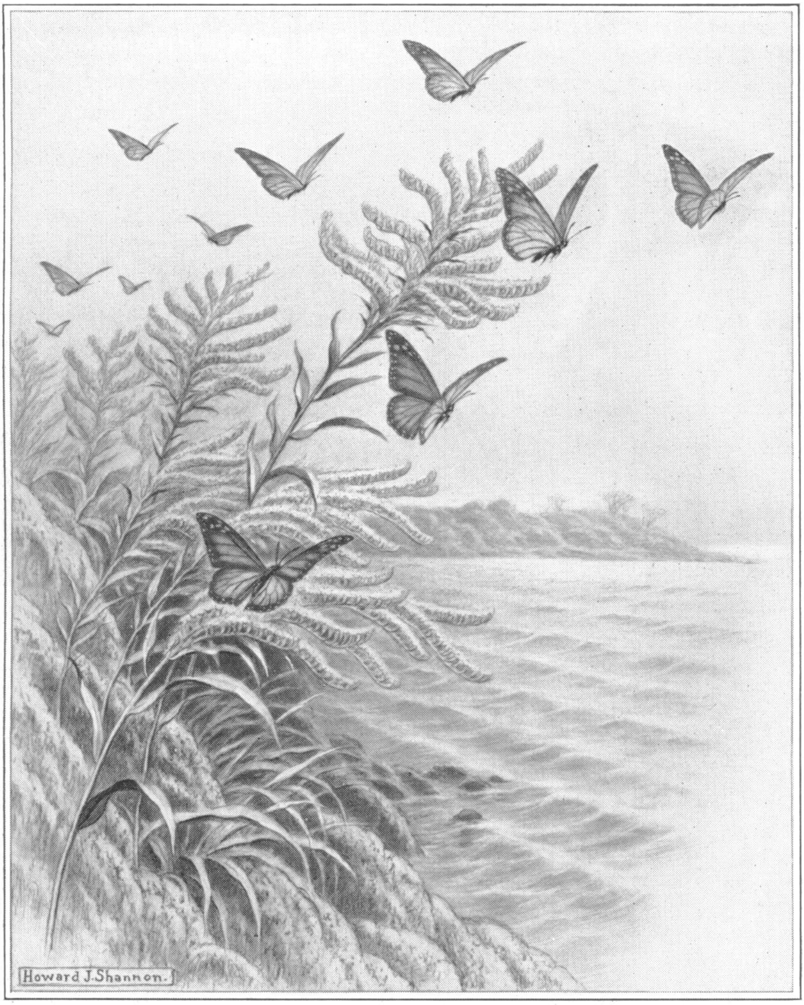
Howard J. Shannon.

FIG. 7. "MONARCHS" MIGRATING ALONG THE CONNECTICUT SHORE. They are setting sail from Welch Point and flying over the Sound waters in order to reach the next peninsula farther to the west. Charles Island, sometimes visited by the migrants, is visible in the distance.

dragons first begin to drift south along our highways in mid-August smaller insect life is still plentiful and widespread. But the same problem confronts us in the case of many birds which begin to arrive from the north before their insect food seems to show any noticeable diminution. Yet in this we may be deceived. Certainly the insect-eating swallows are among the first to start: on the other hand, the seed and berry eaters are among the last to leave. So, whatever results more exhaustive studies may show, the simultaneous early departure of dragonflies and the birds which also prey upon insect food is still another significant coincidence.

The laws, then, which govern the smaller, seasonal migrants seem so undoubted and severe that one can not fail to perceive that more complete and far-gathered data directed toward the problem of their beginning in season and in prehistoric time may even shed an additional light upon the very origin of bird movements. For, notwithstanding the voluminous literature which has grown up about the feathered migrants and the theories of climatic change initiated by the Ice Age as responsible for their annual flux and flow, these annual adventures still remain one of the most inexplicable and marvelous manifestations of animal life. It is equally true that the application of marking and tracing methods to insects (which have long been the practise of the bird student) will now be made possible, owing to the fact that certain of the eastern routes are clearly defined, allowing the naturalist to determine the extent of the southward movement in each species, the place and manner of the winter sojourn, and, also, how many of the northward-moving migrants of spring are new generations bred in that warmer region, and how many are, in very truth, the same individual travelers which set out upon their long, southward journey in the autumn.